Proposal for Evaluation of Artificial Recharge Potential and Automated Monitoring of Groundwater Levels in California Statewide Groundwater Elevation Monitoring Wells

Merced Groundwater Basin
Merced, California

Submitted to:
California Department of Water Resources
Sacramento, California

Submitted by:
AMEC Environment & Infrastructure, Inc.
Fresno, California

July 12, 2012

Proposal 2012-013

5.0 Attachment 5 Work Plan

5.1 Scope of the proposed project including (as appropriate) maps of agency area and area of proposed tasks.

MAGPI has authorized its agent, MID, to secure a grant from the DWR to evaluate: (1) the potential for artificial recharge in the vicinity of El Nido (in southwest Merced Basin), and (2) to install continuously-recording dataloggers to automate the monitoring groundwater elevations in 34 selected CASGEM observation and production wells at strategic locations within the Merced Basin. These tasks are further described below.

5.1.1 El Nido Pilot Recharge Basin Study

MID has acquired to an approximately 25-acre parcel at the southeast corner of the intersection Arbor Way and Cleveland Road in El Nido, Merced County (Figure 3). Over the past 50 years, the former El Nido Irrigation District (a MAGPI agency) had occasionally discharged excess surface water to this parcel where it was observed to rapidly infiltrate. MAGPI proposes to more thoroughly evaluate the recharge potential of this parcel for intentional recharge of groundwater.

The initial subsurface exploration at the site will be conducted using cone penetrometer testing (CPT). CPT is a direct-push technology; as the CPT rod is pushed down into the ground using a hydraulic ram, the CPT measures tip resistance, sleeve friction, and pore water pressure approximated every 2 inches. There is a well established relationship between these parameters and soil type. The result is a continuous, detailed log of soil type with depth.

Between six and eight CPT borings will be advanced to approximately 100 feet below ground surface (bgs) within and around the 25-acre parcel as shown on Figure 3. The depth to groundwater is anticipated to be between 50 and 60 feet bgs. The resulting CPT logs will then be evaluated by a Certified Hydrogeologist to determine if the site is suitable for further investigation. The presence of fine-grained sediments near the surface or a deeper confining layer might preclude use of the site as for intentional recharge.

Assuming the results of CPT logs are positive, monitoring wells will be installed at six locations to first groundwater (the location of the wells will be determined based on the results of the CPT survey). All borings will be installed using the hollow-stem auger method, and soil cutting will be lithologically logged by a field geologist. At least one monitoring well will be installed adjacent to a CPT boring to correlate the lithlogic log with the CPT log. The monitoring wells will consist of 2-inch diameter polyvinyl chloride (PVC) with at approximately 20 feet of well screen. The screen interval will be approximately 15 feet below and 5 feet above the water table.

Based on the evaluation of the CPT data and surface soils, a small (approximately ¼ acre) pilot recharge basin will be excavated by MID to an anticipated depth of 5 feet bgs (the location of the pilot basin and excavation depth will depend on the shallow sediments beneath the site). Excavated soil will be stockpiled on site.

The pilot recharge basin will be plumbed to an adjacent MID surface water canal. Canal water will be metered into the pilot recharge basin by gravity. The rate of percolation (in feet per day) will be measured daily for a period of 3 months to estimate the long-term potential infiltration rate of the pilot basin. Prior to and during the infiltration pilot test, the monitoring wells installed around the site will be instrumented with continuously recording dataloggers to monitor changes in groundwater elevations beneath the site in response to the recharge. The resulting data will be used to estimate short-term and long-term infiltrations rates, evaluate groundwater mounding, and evaluate dissipation of the groundwater mound.

5.1.2 Automated Monitoring of Groundwater Levels in CASGEM Wells

As previously indicated, MID has conducted monitoring of water levels in 290 monitoring and production wells on a quarterly and/or monthly basis since 1991. Although these data are very useful, it may lack timeliness and consistency. Due to the number of monitoring wells involved, it takes several weeks to collect water level measurements from these wells. Also, manual measurement of water level can be inconsistent from operator to operator. In addition, it is difficult to tell from manual measurements if a well was pumping, had recently been pumping, or was at static conditions.

To improve the quality of groundwater monitoring data, approximately 34 CASGEM monitoring and production wells (about 15 percent of the wells) at strategic locations (Figure 4) within the Merced Basin will be instrumented with continuously recording dataloggers. The dataloggers will be equipped with radio frequency telemetry so that they may be downloaded by simply “driving by” without disturbing well operations. The dataloggers will monitor groundwater elevations on approximately hourly frequency so that daily and seasonal variations in groundwater levels may be evaluated. Because the data are continuous, it will be relatively easy to select contemporaneous water levels representative of both static and pumping conditions. This will also permit for the estimation of drawdown at each well as a result of pumping. In addition, the continuous data from the strategic wells will be utilized, along with long-term monthly water level measurements, to evaluate and project future groundwater levels in specific areas of concern (i.e., City of Livingston, City of Merced, and El Nido).

Most importantly, the continuous data from the strategic wells may be utilized to provide base-line data to calibrate and maintain a planned regional scale groundwater and surface water flow model for the Merced Basin.

5.2 Specific purpose, goals, and objectives of the proposed project related to improving groundwater management and implementing the BWMP and/or where applicable the IRWM Plan.

5.2.1 Purpose and Goals

The purpose and goals of this Project is to increase the ability to recharge surface water (when available), further develop an understanding of the hydrogeology of the MGWB, and to apply that understanding to evaluate impacts of increased groundwater use in on sub-basin groundwater levels and quality. The Project will accomplish the following objectives:

- Development of a comprehensive, updated hydrogeologic conceptual model that provides an overall understanding of how the aquifer system works and interacts with surface water.

- Evaluation of changing land use and groundwater conditions that supports a better understanding of land use impacts on surface and groundwater resources.

- Support for ongoing groundwater programs such as the CASGEM program.

- Develop a base line of groundwater elevation data for development of a regional scale conjunctive use numerical model as a tool to assist with land use planning and surface water and groundwater management decisions throughout the sub-basin.

- Support for programs associated with the Merced Groundwater Basin Groundwater Management Plan (GWMP) including recent regulatory requirements of a GWMP such as the mapping of recharge zones as required by Assembly Bill 359 (AB359, 2011).

- Support for the on-going development of the Merced Integrated Regional Water Management Plan as it relates to groundwater recharge and other pertinent water issues.

Analysis of available data will focus on the interconnectivity of aquifer systems, recharge potential, surface water/groundwater interactions, and overall groundwater conditions. The groundwater level data will be compiled into a database to examine changes and trends in groundwater levels over time. Groundwater level contour maps and cross sections will be developed to analyze and illustrate relationships of aquifers and groundwater conditions.

5.2.2 Objectives

This Project is linked to numerous Basin Management Objectives (BMOs) in the Merced GWMP (AMEC Geomatix, 2008). Stated BMOs are summarized below:

- Protect and maintain groundwater quality within the MGWB to satisfy current and future beneficial uses.

- Maintain groundwater quantities and eliminate conditions of long-term over draft in the MGWB to ensure water supply reliability to meet current and future beneficial uses.

- Protect and maintain groundwater recharge areas within the MGWB.

- Manage the MGWB with local control.

It is clear that the proposed Project directly supports the first three BMOs. Evaluating and developing additional surface water recharge facilities at the El Nido basins directly applies to all four BMOs. The long-term high-frequency monitoring

of the CASGEM wells will help to evaluate long-term overdraft, evaluate surface water/groundwater interactions, and allow for the better management of groundwater resources (BMOs 2, 3, and 4).

This Project will result in the collection of high-frequency groundwater level elevation data that can append other databases (MID, CASGEM) and provide a base line of groundwater level data for further development and calibration of a planned integrated surface water/groundwater resources model. The plan for this conjunctive use modeling efforts was initiated a few years ago. MAGPI currently has obtained a matching fund of $500,000 from DWR to develop such a conjunctive use model for the Merced Basin. This project will be underway as soon as matching funds become available. About $200,000 additional funds are yet to be realized. The purpose of the conjunctive use integrated surface water/groundwater resources modeling is to optimize the conjuctive use of both surface water and groundwater resources to benefit all stakeholders in the Merced Basin. The model will simulate interactions between surface supplies and groundwater flow and will be used as a tool to effectively manage various sources of water supplies and minimize groundwater overdraft.

The Project report will contain extensive documentation on data collection efforts and sources so that future users know which data sets have been incorporated.

5.2.3 Integrated Regional Water Management

The Merced Region is currently developing an Integrated Regional Water Management Plan (IRWMP). This effort was initiated by MAGPI, which serves as an interim Regional Water Management Group responsible for developing the IRWMP. The objectives and goals of IRWMP are in agreement with a wide variety of local water plans, programs, and policies already in place. There will be an on-going dynamic relationship between the existing local plans and the IRWMP in development. One of the primary objectives of the IRWMP and the Merced County General Plan is to identify opportunities using modern technologies and sound science to preserve and/or increase the quantity of groundwater resources through integrated groundwater recharge programs and management. Other key components of the IRWMP are water conservation, integrated flood and storm management, salinity and nutrients, and climate change impacts.

The IRWMP will be utilized as a basis in which water projects may be implemented and built from an integrated approach. The proposed recharge basin study and the automated groundwater level network will then establish the background support for a groundwater recharge program and future water resources management through modeling tools.

The Merced Integrated Regional Water Management group has reached out to other sourrounding integrated regions in the San Joaquin River Basin for purposes of coordinating and collaborating on water projects that would impact all parties. The Merced Region has entered agreements with Madera and Yosemite-Mariposa Regions with MOUs to cooperate on issues that may affect one another.

5.3 Work items to be performed under each task of the proposed tasks (consistent with the budget and schedule).

The proposed project has been subdivided into eight task items, including specific task descriptions and deliverables. These are described below.

5.3.1 Task 1 – Project Management and Public Outreach

This task item provides for initial project management during project startup (scheduling, budging, contract negotiation, etc.) and a public outreach program for the duration of the project. A public website will be hosted by MID as part of a public outreach program to allow the public to monitor the progress of the project and provide feedback to the cooperating agencies. The website will be updated quarterly with various deliverables including:

- Memorandum listing cooperating agencies and contact persons.
- Copies of minutes from MAGPI steering committee meetings.
- Copies of minutes from Technical Committee meetings.
- Copies of quarterly progress reports to DWR.

5.3.2 Task 2 – CPT Exploration Drilling

This task item provides for CPT exploration at the El Nido location. Gregg Drilling and Testing, Inc., will advance six to eight CPT borings at the 25-acre El Nido parcel to evaluate subsurface conditions. These properties are owned by MID, a MAGPI member agencies, so access is assured. The location of each CPT boring will be determined using a handheld GPS. All CPT borings will be performed in accordance with ASTM International Standard D-5778-95. As the CPT rods are withdrawn, the hole will be backfilled with a bentonite slurry. The CPT borings will be observed by a field geologist under the direct supervision of a California Registered Geologist. The resulting boring logs will be evaluated by a Certified Hydrogeologist and included in the final report. These geologic data will be evaluated to construct geologic cross sections and to evaluate the hydraulic properties of the subsurface alluvium.

Deliverables for this task will include:

- CPT logs for each CPT boring,
- GPS locations and elevation surveys for each CPT boring, and
- cross-sections and/or fence diagrams of subsurface lithology.

5.3.3 Task 3 – Monitoring Well Installation

This task provides for the installation and sampling of monitoring wells, assuming the Task 2 results are favorable. Gregg Drilling and Testing, Inc., will install approximately six monitoring wells at the El Nido property to monitor shallow groundwater beneath the site. Drilling permits will be obtained from Merced County Department Health Services (MCDHS) prior to initiating drilling activities. The well boring will be advanced by the hollow-stem auger method to a depth of approximately 60 to 70 feet bgs (about 15 feet below the estimated water table). Soil cutting will be lithologically logged by a field geologist under the direct supervision of a California Registered Geologist. At least one monitoring well will be installed adjacent to a CPT boring to correlate the lithlogic log with the CPT log. The resulting lithologic logs will be evaluated by a Certified Hydrogeologist and included in the final report.

The monitoring wells will consist of 2-inch diameter PVC with approximately 20 feet of well screen. The screen interval will be approximately 15 feet below and 5 feet above the top of the water table. The monitoring wells will be constructed in accordance with MCDHS guidelines. Following construction, the wells will be developed by bailing and surging until the produced water is clear and relatively free of sediment. After development, a groundwater sample will be collected from each well to establish background water quality. The water samples will be submitted to a State-certified laboratory under chain-of-custody procedures for analysis of general minerals. Soil cutting and development water will be stockpiled on site. The location and elevation of the monitoring wells will be surveyed by a licensed land surveyor. The resulting lithologic data will be evaluated to construct geologic cross sections and to evaluate the hydraulic properties of the subsurface alluvium.

Deliverables for this task will include:

- MCDHS drilling permits,
- surveyed location and elevation for each monitoring well,
- lithologic logs for each well boring,
- well construction diagrams for each monitoring well,
- cross-sections and/or fence diagrams of subsurface lithology, and
- and initial water quality analyses for general minerals.

5.3.4 Task 4 – Pilot Recharge Basin Construction

This task provides for the construction and testing of a pilot recharge basin, assuming that the Tasks 2 and 3 results are favorable. MID will provide in-kind staff effort and equipment to construct an approximately ¼-acre pilot test basin to an anticipated depth of 5 feet bgs at the El Nido property. The location of the pilot basin and excavation depth will depend on the shallow sediments beneath the site. The pilot test basin will be enclosed by temporary fencing to limit access and secure the site. Excavated soil will be stockpiled on site.

The pilot recharge basin will be plumbed to an adjacent El Nido surface water canal by MID staff. It is anticipated that canal water will flow into the pilot recharge basin by gravity. The recharge water will be metered and controlled by a float value system to maintain a near constant head of about 2 feet in the test basin. The rate of percolation (in feet per day) will be measured daily for a period of 3 months to estimate the long-term potential infiltration rate of the pilot basin. Prior to and during the infiltration pilot test, the monitoring wells installed around the site will be instrumented with MID owned continuously recording dataloggers to monitor changes in groundwater elevations beneath the site in response to the recharge. Near the end of the recharge period, a groundwater sample will be collected from each well to evaluate changes in water quality, if any. The water samples will be submitted to a State-certified laboratory under chain-of-custody procedures for analysis of general minerals. The resulting data will be used to estimate short-term and long-term infiltrations rates, evaluate groundwater mounding and subsequent dissipation (if any), and evaluate changes in groundwater quality results from recharge (if any).

Deliverables for this task will include:

- An as build diagram of the pilot test basin facility,
- tabulated daily flow into the basin and calculated infiltration rates,
- estimated long-term infiltration capacity of full scale facility,
- long-term hydrographs for each monitoring well, and
- evaluation of effect of recharge on groundwater levels and quality.

5.3.5 Task 5 – Automated Datalogger Network Procurement

This task provides for the design and procurement of automated groundwater level dataloggers and associated equipment for 34 CASGEM wells within the Merced Basin (Figure 4). It is anticipated that a Schlumberger Diver–Netz wireless groundwater network will be procured. This system will consist of 34 Mini-Diver submersible pressure/temperature dataloggers and associated coaxial cabling, 34 Diver-DXT wireless transceivers, 2 Baro-Diver barometers dataloggers, and 2 Archer Reader wireless hand-held data recorders. The sounding tube length, datalogger cable length, pressure transducer range, and transceiver placement will be specifically designed for each well to assure proper operation. The barometers will be placed at strategic locations to provide atmospheric corrections for the groundwater level measurements for wells within that area.

Deliverables for this task will include:

- Equipment design specifications and diagrams for each well,
- thirty four Mini-Diver submersible pressure/temperature dataloggers and transceivers,

- two Baro-Diver barometers dataloggers, and
- two Archer wireless data recorders.

5.3.6 Task 6 – Automated Datalogger Installation and Network Setup

This task provides for the programming, installation, and testing of the automated groundwater level dataloggers and associated equipment for 34 CASGEM wells within the Merced Basin (Figure 4). MID staff, in cooperation with other MAGPI agencies will provide in-kind staff effort and a well development rig (or equivalent) to raise and modify the well head assembly at each well so that a 1-inch diameter sounding tube can be installed. The length of the sounding tube will be well specific. The well specific Mini-Diver submersible pressure/temperature datalogger and transceiver will be programmed to record groundwater levels and temperature every hour and the datalogger assembly installed in the well. It is anticipated that the radio transceiver will be place at a convenient, elevated location at each well. At selected locations, a barometer will also be installed. Following installation, each well (and barometer) will be tested with the Archer wireless data recorder to verify communication.

Deliverables for this task will include:

- As built diagrams of dataloggers and transceivers locations for each well, and
- as built diagrams of barometers installation at strategic locations.

5.3.7 Task 7 – Automated Network Monitoring

This task provides for the monitoring of the CASGEM well monitoring network for a period of at least 1 year. MID will provide in-kind staff effort to visit and download the network wells once each quarter. The data will be entered into a database and used to prepare long-term hourly hydrographs, contemporaneous potentiometric surface maps, and evaluate the relationship between groundwater levels and well production. Static and producing groundwater levels will also be compared to estimate drawdown on a seasonal basis.

Deliverables for this task will include:

- Tabulated groundwater elevation data for each well,
- long-term hourly hydrographs for each well,
- contemporaneous potentiometric surface maps, and
- seasonal drawdown calculations for each well.

5.3.8 Task 8 – Reporting

This task provides for the preparation of status and technical reports. Quarterly progress reports will be provided to DWR, including accomplishments from the past quarter and anticipated activities for the next quarter. Progress will be tracked with a project management Gantt chart, which will accompany the quarterly reports. Upon completion of the project, a draft technical report will be submitted to DWR. This report will contain all data collected in conjunction with the program (CPT logs, boring logs, well construction diagrams, El Nido pilot recharge testing results, datalogger specifications and as built diagrams, tabulated data, etc.) along with hydrographs, cross sections, and potentiometric surface maps developed from those data. The report will evaluate the recharge potential at the El Nido property and summarize the results of the automated monitoring network of strategic wells. The report will also assess how goals have been met by the program and provide recommendations for evaluating any outstanding questions remaining upon completion of the investigation. A final report will be prepared incorporating review comments received from DWR on the draft report.

Deliverables for this task will include:

- Quarterly progress report to DWR summarizing field activities and data collected to date,
- the quarterly progress reports will be posted to the project website for public review,
- a draft technical report to DWR summarizing data collected during the project and evaluating the recharge potential of El Nido and Cressey Basin properties, and
- a final technical report.

5.4 Present a sound strategy for evaluating progress and performance at each step of the proposed project.

5.4.1 CPT & Monitoring Well Installation

The CPT borings and soil cutting will be lithologically logged by a field geologist under the direct supervision of a California Registered Geologist. At least one monitoring well will be installed adjacent to a CPT boring to correlate the lithlogic log with the CPT log. The resulting lithologic logs will be evaluated by a Certified Hydrogeologist and included in the final report. Should the subsurface data indicate the presence of a significant confining layer, then the pilot recharge basin may be reconsidered.

5.4.2 Pilot Recharge Basin Construction

This task provides for the construction and testing of a pilot recharge basin, assuming that the Tasks 2 and 3 results are favorable. MID staff will use an excavator to construct an approximately ¼-acre pilot test basin to an anticipated depth of 5 feet bgs at the El Nido property. The location of the pilot basin and excavation depth will depend on the shallow sediments beneath the site. The pilot

test basin will be enclosed by temporary fencing to limit access and secure the site. Excavated soil will be stockpiled on site.

The pilot recharge basin will be plumbed to an adjacent El Nido surface water canal by MID staff. It is anticipated that canal water will flow into the pilot recharge basin by gravity. The recharge water will be metered and controlled by a float value system to maintain a near constant head of about 2 feet in the test basin. The rate of percolation (in feet per day) will be measured daily for a period of 3 months to estimate the long-term potential infiltration rate of the pilot basin. Prior to and during the infiltration pilot test, the monitoring wells installed around the site will be instrumented with MID owned continuously recording dataloggers to monitor changes in groundwater elevations beneath the site in response to the recharge. Near the end of the recharge period, groundwater sample will be collected from each well to evaluate changes in water quality, if any. The groundwater samples will be submitted to a State-certified laboratory under chain-of-custody procedures for analysis of general minerals. The resulting data will be used to estimate short-term and long-term infiltrations rates, evaluate groundwater mounding and subsequent dissipation (if any), and evaluate changes in groundwater quality results from recharge (if any).

5.5 Project deliverables for assessing progress and accomplishments which include quarterly progress and final reports.

5.5.1 Project Deliverables

This task provides for the preparation of status and technical reports. Quarterly progress reports will be provided to DWR, including accomplishments from the past quarter and anticipated activities for the next quarter. Progress will be tracked with a project management Gantt chart, which will accompany the quarterly reports. Upon completion of the project, a draft technical report will be submitted to DWR. This report will contain all data collected in conjunction with the program (CPT logs, boring logs, well construction diagrams, El Nido pilot recharge testing results, datalogger specifications and as built diagrams, tabulated data, etc.) along with hydrographs, cross sections, and potentiometric surface maps developed from those data. The report will evaluate the recharge potential at the El Nido property and summarize the results of the automated monitoring network of strategic wells. The report will also assess how goals have been met by the program and provide recommendations for evaluating any outstanding questions remaining upon completion of the investigation. A final report will be prepared incorporating review comments received from DWR on the draft report.

5.6 If access to private property is needed, provide assurance that access can be granted.

The identified environmental compliance and permits required include drilling permits from the MCDHS. Access agreements will not be required as the property and wells being utilized belong to cooperative MAGPI member agencies. The El Nido property has been used for occasional recharge of excess surface water over the past 50 years. As such, the proposed pilot recharge test at the property will not constitute a significant long-term change in land use; therefore, a California Environmental Quality Act (CEQA) document is not anticipated.

5.7 Explain the plan for environmental compliance and permitting, including a discussion of the following:

- Description of the plan, proposed efforts, and approach to environmental compliance including any CEQA obligations.
    - The identified environmental compliance and permits required include drilling permits from the MCDHS. Access agreements will not be required as the property and wells being utilized belong to cooperative MAGPI member agencies. The El Nido property has been used for occasional recharge of excess surface water over the past 50 years. As such, the proposed pilot recharge test at the property will not constitute a significant long-term change in land use; therefore, a CEQA document is not anticipated.
    - MID has two water right licenses totaling about 10,000 acre-feet for underground storage in the El Nido area from Duck Slough.
- Listing environmental related permits or entitlements that are needed.
- Any other applicable permits.
- Briefly describe process and schedule for securing each permit/approval.
- Discuss necessary local drilling permits and submittal of Well Completion Reports to DWR.
- Describe proposed process for securing each environmental permit and any other regulatory agency approval.